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ABSTRACT

The purpose of precision teaching is to modify those academic or social behaviors that are in need of change, as effectively and efficiently as possible. Development of a precision teaching program involves pinpointing the target behavior, administering daily probes, charting the data, setting the aim, implementing the instructional strategies, and evaluating the program. The target behaviors must be able to be pinpointed, meaning they must be observable, repeatable, and have a discrete beginning and ending point. The pinpointed behaviors have five characteristics: frequency, duration, latency, magnitude, and intensity. The level of functioning must be determined for each student within each academic area; this is accomplished through the development and administration of three types of probes: mixed probes, single probes, and tool skill probes. Guidelines are offered for developing, administering, and scoring probes. The data resulting from the probes are then graphed on a chart. Following these baseline measurements, an intervention condition is implemented. In this phase, an instructional goal is made, an instructional strategy is selected, and the frequency data are charted. The effectiveness of the intervention can then be measured through graphing. Graphs and learning exercises for teachers are incorporated throughout the text. (JDD)

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PRECISION TEACHING:
A MANUAL FOR CLASSROOM TEACHERS

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INTRODUCTION

Data-based instruction is the direct and continuous measurement of a learner's progress toward specific instructional objectives (Blankenship & Lilly, 1981). Direct measurement refers to the measurement of actual samples of the student's academic behavior. When these samples of academic behavior are collected and graphed daily (continuously), data-based decisions regarding the students instructional program can be made before there is an adverse affect on the student. To illustrate the concepts of direct and continuous measurement, a student may be asked to complete a sheet of single digit addition facts. The number of correct and incorrect addition facts that the student completes provides a direct measure of the student's single digit addition performance. Data regarding the student's performance on the addition facts is then collected and graphed each day. Likewise, when a student reads a passage from a book, the number of words read correctly and incorrectly (direct measurement) can be collected continuously and charted.

In contrast to data-based instruction, is a system that uses indirect and periodic measures of academic behavior. This system of instruction frequently relies on the use of standardized test instruments, which are considered indirect measures of performance. The tests make educational inferences and provide general information regarding the student's academic performance by testing only a limited portion of the student's

skills. Because the tests are only administered periodically (e.g. to determine educational placement or to measure how the students are performing within the school's curriculum), they are not representative of a continuous measurement system.

Precision teaching is a type of data-based instruction that has its roots in both the behavioral and scientific management movements. Although many of the principles were used by August Dvorak in the 1930s, full development of the technology did not occur until Ogden Lindsley formalized the system in 1964 (Joyce & Moxley, 1988). Precision teaching is considered a type of data-based instruction because it includes both direct and continuous measurement of a target behavior. Unlike most data-based instruction programs, which enable the individual to select any type of measurement system, precision teaching is more "precise" because it utilizes specific rules regarding the measurement system. It provides a systematic evaluation of whatever teaching strategy a teacher might implement by giving the teacher information regarding when a modification of the strategy is warranted (White, 1986). It does not, however, change the teacher's basic approach to instruction. Precision teaching enables teachers to become more effective and expedient in adapting their teaching style to better meet each student's individual needs.

The procedures involved in implementing a precision teaching program include; pinpointing the target behavior, administering daily probes, charting the data, setting the aim, implementing

the instructional strategies, and evaluating the program. Each of these procedures will be discussed in subsequent chapters.

CHAPTER 1

PINPOINTING

The purpose of precision teaching is to modify those behaviors (academic or social) that are in need of change, as effectively and efficiently as possible. To accomplish this task, the behaviors must be countable and thereby have three properties; observable, repeatable, and have a discrete beginning and ending point. The process for identifying and describing countable behaviors is referred to as pinpointing (Koorland & Martin, 1975).

An observable behavior refers to any behavior that can be seen or heard. If, for example, a student is instructed to read a passage from a book, then the behavior is considered observable because the teacher hears the words and can measure the behavior directly (correct and incorrect oral responses). If, however, the student reads the passage silently, then the behavior can not be measured directly because little information can be attained regarding the accuracy of the responses or the student's decoding skills. It therefore, is more advantageous to select those behaviors that are concrete and readily observable.

For a behavior to be repeatable, it must occur more than once. Pinpointed behaviors must be repeatable because it is difficult to measure the effectiveness of an instructional strategy if the behavior does not occur more than once.

Examples of repeatable behaviors include reading (occurs more that once as each word is read), writing, and talking-out.

Pinpointed behaviors also must have a discrete beginning and ending point. It is necessary for the behavior to stop so it can begin again and, hence, be repeatable and countable. Writing is a behavior that can be pinpointed because it is observable, repeatable, and has a discrete beginning and ending point (each written word ends and a new word begins).

ACTIVITY 1

Read the behaviors below and indicate which are pinpoint behaviors by placing an "X" in the "Yes" column. Mark nonpinpoint behaviors by placing an "X" in the "No" column. For each nonpinpoint behavior, indicate why it is not a pinpoint behavior in the space provided. Check your answers with the key following the activity.

STATEMENTS	YES	NO
1. Writing answers to addition facts		
2. Thinking clearly		
3. Talking		
4. Measuring a line		

5. Reading silently_____

_____

6. Listening to a record_____

_____

7. Strumming strings on a guitar_____

_____

ANSWER KEY

1. Yes
2. No. Thinking is considered a private event rather than a pinpoint behavior because it can not be observed directly and thus there is no way to determine when it begins and when it ends.
3. Yes
4. Yes
5. No. Reading is also considered a private event because it can not be observed and measured directly and thus little information can be collected regarding the accuracy of the behavior. Although the teacher might ask the student questions about the reading passage, incorrect responses might indicate that the student failed to read the passage, failed to understand the questions, or failed to understand the written material.
6. No. This behavior can not be observed and measured directly because the student might be able to hear the music but might be engaging in other private behaviors (e.g.

"thinking" about something else).

7. Yes

PINPOINT STATEMENTS

To clearly describe an academic pinpoint behavior, a statement regarding the behavior should include the intake channel, output channel, and object word. The intake channel refers to the process by which the student receives information. Intake channels include see, hear, touch, smell, and taste. The output channel refers to the student's response to the information that he or she receives. These generally include action words such as read, write, and jump. The object word refers to the object of the action such as letters, words, and sentences. Examples of pinpoint statements include:

see	say	alphabet letters
(intake channel)	(output channel)	(object word)
hear	write	vocabulary words
(intake channel)	(output channel)	(object word)
touch	say	object names
(intake channel)	(output channel)	(object word)
smell	say	names of spices
(intake channel)	(output channel)	(object word)

ACTIVITY 2

Read the examples below and write the pinpoint statement

after each example. Check your answers with the key following the activity.

1. Susan counts money.

_____

2. John says names of letters as he touches letters made from sandpaper.

_____

3. Jane punctuates sentences in her grammar book.

_____

4. Carl spells words orally after he hears the words.

_____

5. Ann points to words on her worksheet as she hears the words.

_____

Answer Key:

1. See-count money.
2. Touch-say letter names.
3. See-write punctuation marks.
4. Hear-spell words orally.
5. Hear-point to words.

SLICING

Slicing is the process of reducing a behavior into a more frequently occurring component. Slicing is used when a teacher wants to observe and record a specific student behavior but

notices that the behavior does not occur frequently enough to provide sufficient opportunities for measurement. A teacher, for instance, might be interested in recording the number of completed homework assignments that a student finishes. If the student consistantly completes only one assignment or starts several assignments but fails to complete any of the assignments, then the teacher might slice "completed assignments" into completed pages, completed rows, or completed problems. The rule of thumb is to start "where the student is functioning," and then reinforce the student for increases in performance. That is, if the student averages around three rows of completed work, then start reinforcing those initial efforts. Gradually increase the amount of work to be completed in order to receive the same amount of reinforcement.

CHAPTER 2

Characteristics of Behavior

After a behavior has been pinpointed, it is necessary to determine what characteristic of the behavior is necessary to count. There are five characteristics of behavior including frequency, duration, latency, magnitude, and intensity. Although precision teaching can be used in the evaluation of all characteristics of behavior, it is primarily concerned with frequency, and to a lesser (but still important) extent with duration and latency.

FREQUENCY

The emphasis on the measurement of frequency is a primary factor that distinguishes precision teaching from other data based instruction systems. Frequency is emphasized because skills tend to be retained over periods of disuse when high rates of responding are achieved. In addition, when specific skills are mastered (high frequency with few errors), then skill acquisition for subsequent curricular steps is rapid (Berquam, 1981a, 1981b). Frequency refers to the rate of response or the number of behaviors that occur per minute and is calculated by dividing the number of times a specific behavior occurs by the number of minutes recorded (Pennypacker, Koenig, & Lindsley, 1972). The formula for frequency is:

$$F = \frac{\text{number of behaviors}}{\text{number of minutes}}$$

Sometimes, the number of minutes is not a whole integer, but includes minutes plus seconds (e.g. 1 minute, 30 seconds). When this occurs, the seconds must be converted to a fractional part of a minute (e.g. 30 seconds = .5 minute) before calculating the frequency. Seconds can be converted to minutes by dividing the number of seconds by 60. A table showing seconds and fractional parts is listed in Appendix A.

ACTIVITY 3

Read the statements below and calculate the frequency of the behavior using the formula for frequency. Record the frequency in the space after each statement. It is important to record the unit, "per minute", after each frequency value. Check your answers with the key following the activity.

1. Sam completes 6 subtraction problems in 3 minutes.

   _____

2. Jane jumps rope 10 times in 30 seconds.

   _____

3. Sue writes 30 alphabet letters in 1 minute.

   _____

4. Bob talks 11 words in 15 seconds.

   _____

5. Connie gets out of her seat once every hour.

ANSWER KEY

1. 6/3 = 2 problems per minute.
2. 10/.5 = 20 jumps per minute.
3. 30/1 = 30 letters per minute.
4. 11/.25 = 44 words per minute.
5. 1/60 = .017 out of seats per minute.

When precision teachers first began using frequency as a measure of student performance, they quickly realized that speed did not always correspond to improvement (Pennypacker, et al., 1972). A student could become faster without improving his or her performance. A measure was needed so that changes in performance could be evaluated in terms of accuracy as well as speed. Precision teachers have consequently included both frequency and accuracy to measure changes in student performance. Data regarding the frequency of correct responses and the frequency of the incorrect responses for each pinpoint behavior is collected and recorded. This is in contrast to traditional evaluation systems that measure only the <u>number</u> of correct and incorrect responses and do not consider the frequency or rate at which these responses are made. For instance, if a teacher wants to measure the student's performance in addition facts, then the precision teacher

calculates the number of correct addition facts per minute as well as the number of incorrect addition facts per minute. In contrast, the regular teacher generally records the number orpercent corrrect and/or incorrect but fails to consider the precise amount of time that was necessary for the student to complete the problems.

The use of frequency in the measurement of student performance is important because frequency is considered a more sensitive measure of behavior (Johnston & Pennypacker, 1980). For instance, in traditional evaluation systems, assessments are composed of subtests that are timed (e.g. 30 minutes per subtest). One student might complete all questions within the first 5 minutes with 95% accuracy. Another student might also achieve 95% accuracy but take 30 minutes to answer all questions. Thus both performances are 95% correct but the time taken to produce them differs greatly. Traditional evaluation systems do not reflect this difference, yet this difference is important in evaluating student performance and is functionally related to success in the natural environment.

DURATION

Duration is the amount of time that the behavior occurs. The formula for duration is:

$$D = \frac{1}{\text{number of minutes that behavior occurs}}$$

If a behavior occurs periodically throughout the day (e.g. student stares out the window), then the teacher can count and total the number of minutes that the student engages in the behavior and divide this total number of minutes into 1.

Measures of duration are calculated and recorded when the teacher wants to modify the length of time that a student engages in a particular behavior. A teacher, for instance, might notice that a student readily starts his or her assignments when requested, but fails to work on the assignments for periods longer than a few minutes. The student works quickly (has a high rate of responding per minute), but the few minutes of on-task behavior do not provide the student with ample practice that is needed to reach proficiency. The difficulty, therefore, is not with frequency but is with duration. Besides charting duration data for on-task behavior (or length of attention span) a teacher might be interested in the amount of time a student sits in one's seat or sleeps during class.

ACTIVITY 4

Read the statements below and calculate duration measures for each statement. Check your answers with the answer key following the activity.

1. John chews gum from 8:00 AM to 11:00 AM.

_____

2. Cindy chain smokes cigarettes for 1.5 hours.

_____

3. Bob runs for 45 minutes.

_____

4. Wanda sharpens her pencil for 4 minutes in the morning and for 5 minutes in the afternoon.

_____

5. When sitting, Carl tilts his chair back and rocks on the back two legs of the chair for 10 minutes, 5 minutes, and 15 minutes during history class.

_____

ANSWER KEY

1. 1/180 = .006
2. 1/90 = .01
3. 1/.75 = 1.33
4. 1/9 = .11
5. 1/.5 = 2.0

LATENCY

Latency is the amount of time that elapses between the end of the stimulus or signal and the start of the response or movement. The formula for latency is:

$$L = \frac{1}{\text{number of minutes from end of stimulus to start of response}}$$

Latency is used when the teacher wants to measure the time between a signal (usually a teacher's instruction) and when the student begins to appropriately respond. This measure is particularly useful for those students who are "slow" to respond to the teacher's requests. If, for instance, a teacher requests the students to start their math assignment and one student sharpens his pencil, goes to the restroom, and cleans his desk before getting started on the assignment, then charting measures of latency would be useful in decreasing the time the student engages in off-task behavior before starting an assignment.

ACTIVITY 5

Read the statements below and calculate the latency measures. Check your anwers with the Answer Key following the activity.

1. At 10:00 AM, Mrs. Smith requests Sam to start reading his geography book. Sam proceeds to sharpen his pencil and talk to Jeff before beginning to read his book at 10:07 AM.

   _____

2. Mr. Johnson requests Alice to sit in her seat. Alice sits down within 3 seconds.

   _____

3. Mr. Brown, the principal, requests that Mr. Jones, the art teacher, complete a requisition for so new supplies can be ordered. Exactly four hours later, Mr. Jones gives the form

to Mr. Brown.

---

4. Ms Fletcher requests Barbara to wash the blackboards. Five minutes, 30 seconds later, Barbara starts washing the boards.

---

5. At 9:30 AM Arnold requests that Frank get his homework out so Mr. Arnold can review it. Frank proceeds to go to the restroom, wander around the library, and stop at the water fountain, before showing Mr. Arnold a half completed homework assignment at 9:55 AM.

ANSWER KEY

1. 1/7 = .14
2. 1/.05 = 20
3. 1/240 = .004
4. 1/5.5 = .18
5. 1/.42 = 2.38

CHAPTER 3

PROBE DEVELOPMENT

One of the first tasks confronting a teacher is to determine the level of functioning for each student within each academic area. In precision teaching, this task is accomplished through the development and administration of three types of probes. These probes are described below.

MIXED PROBE

A mixed probe is an informal test that contains a compilation of all skills in an academic strand or in several strands. For example, a mixed probe in addition might consist of problems involving single digit, two digit plus one digit, two digit plus two digit (with and without carrying), three digit plus one digit, three digit plus two digit, three digit plus three digit (with and without carrying), etc. In contrast, a mixed reading probe for the second grade might require the student to read the sight words from graded reading texts. The purpose of a mixed probe is to identify the strengths and weaknesses that each student has in each area. Appendix B provides an example of a mixed probe.

Although other probes may be substituted based on the level or grade of the student, typical mixed probes include:

Basic addition

Basic subtraction

Basic multiplication

Basic division

Sight words

Texted reading

Basic phonics

Writing manuscript letters (student writes all alphabet letters on blank or lined paper)

Writing cursive letters

Teachers teaching in the primary grades generally develop their own mixed probes. Commercially prepared probes, however, are available. Trifiletti, Rainey, and Trifiletti (1979), for instance, provide a battery of probes for the primary grades called the Sequential Precision Assessment Resource Kit (SPARK II). The Florida Department of Education (1983) also publishes a resource manual containing numerous examples of probes for the classroom teacher. For the secondary level, teachers are encouraged to develop their own mixed probes so the probes directly reflect the topic or subject area.

When administering mixed probes, it is important that the student have sufficient time to complete the entire probe. Frequency is not a crucial issue at this point. Instead, the emphasis is on identifying the students' skills for each area. Each mixed probe should be administered at least twice but not more than three times. Two to three probe administrations provide reliability of student performance while avoiding frustration and repeated practice of academic errors.

After administering the mixed probes to the students, it is important for the teacher to score the probes immediately so more definitive information regarding the students' performance can be attained. Because there are different skills on the mixed probe, each skill must be scored separately. Student proficiency for each skill on each mixed probe should then be classified into one of the following stages.

Accuracy Stage:	All movements for a particular skill are correct
Fluency Building Stage:	50%-99% of the movements are correct (error movements are less that 50% but not 0%)
Acquisition Stage:	Less than 50% of the movements are correct (error movements are more than 50%)

SINGLE PROBE

After identifying the student's level for each skill, the student is administered a single probe for each skill at the Accuracy and Fluency Building Stages. A single probe is a timed probe consisting of a single skill (e.g. single digit addition with sums less than 10). These probes are usually one minute in duration but can vary from 30 seconds to around 3 minutes.

Frequency, or the rate of responding, is a major emphasis of these probes. Appendix C provides an example of a single probe.

Single probes are administered for skills in the Acquisition Stage to determine the frequency of these skills. Although the accuracy of the performance on the skills is identified through the mixed probe, the single probe is necessary to identify the frequency of the skills. After administering a single probe for each skill occurring in the Acquisition Stage, the teacher should refer to Appendix D. This Appendix provides proficiency levels for reading, spelling, and arithmetic (Starlin & Starlin, 1973a, 1973b). If the student is performing at the independent level (the student is accurately responding at a high frequency), then the student does not require instruction in this task and is ready to move to a more advanced skill. If the student is performing at the instructional level, then active instruction of this skill should be provided. If the student is performing at the frustration level, then the skill should be sliced and instruction provided at a prerequisite skill.

Single probes are also administered for those skills occurring at the Fluency Building Stage as this stage will probably yield the most number of skills at the instructional level. To identify the level of instruction, the teacher again should refer to Appendix D.

TOOL SKILL PROBE

A tool skill probe is an informal test that is generally administered for 1 minute. Although other tool probes might be

appropriate (depending on the task), the basic tool skill probes include:

Say digits 0-9

Write digits 0-9

Say letters a-z

Write letters a-z

The purpose of the tool skill probe is to identify the student's frequency on a basic skill that functions as a prerequisite for the development of other skills. If, for instance, a student's performance on a tool skill for writing digits 0-9 is at a frequency of 8 digits per minute, then the student can not be expected to write responses to arithmetic problems faster than he or she can perform the tool skill. In this particular situation, the student needs instruction and practice at increasing his or her frequency of the tool skill because, even if arithmetic problems are completed at the same pace as the tool skill (which is unusual), such performance places the student at the frustration level (based on information in Appendix D). Appendix E provides an example of a tool skill probe.

INITIAL SCHEDULE FOR ADMINISTERING PROBES

The schedule for administering the different types of probes is listed below. For the first day of class, the tool skill

probes (T) are administered first and are followed by two or three administrations of each mixed probe (M). For day two, those tool skill probes that function as precursers to the skills contained in the selected single probes (S), based on results from the mixed probes, should be administered. The tool skill probes, should continue to be administered each day for two reasons. First, if the student does not have sufficient speed on the tool skill, then administration of the probe will function as a "drill and practice" technique to increase the student's frequency. Second, the fast rate of responding that generally occurs on the tool skill probe, will generalize to the other probes. Hence, it is advisable to administer the tool skill probe each day before administering the other probes.

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
T	T	T	T	T
M	S	S	S	S
M	S	S	S	S

GUIDELINES FOR PROBE DEVELOPMENT

When developing probes, there are several guidelines for making a well constructed probe. These guidelines are provided below:

1. Write the pinpoint statement on the probe, preferrably on

the back side of the probe sheet.

2. Put all directions and identifying information on the back side of the sheet so the extra stimuli does not interfere with the students' performance. Information (e.g. number of minutes, number correct, number incorrect) for calculating the frequency (or duration or latency) also should be included on the back.
3. Keep the front side of the probe plain and simple. Refrain from placing decorative stimuli on the probe.
4. Use typewriter (or computer) letters/numbers that approximate the size found in the students' books. Print that is too small reduces the students' frequency. Frequency is also reduced if the teacher writes (or prints) the problems by hand.
5. Turn the paper side ways to print the letters, words, problems, etc. This permits the students to complete more responses before skipping down to the next row and thereby saves time and hence increases frequency.
6. After developing a new probe, pre-administer it to a few students to identify potential problems in advance.
7. Photocopies of probes are preferrable to mimeographed copies because they provide greater contrast and thereby enable the students to respond faster.
8. Because photo-copying is expensive, probes can be inserted in a transparency requiring the students to respond using a water soluable marker. If transparencies are used, then

non-glare transparencies are recommended. These provide a clearer image of the probe and are generally more durable.

9. When developing the probes, it is best to task analyze the skill so that problems reflecting all subcomponents of the skill are represented in the probe. Mercer and Mercer (1985, pp. 502-528) provide a task analysis in their Scope and Sequence Skill Lists for arithmetic, reading, spelling, handwriting, and written expression. Such lists are very helpful when developing mixed probes.

ACTIVITY 6

Develop a mixed, single, and tool skill probe. When finished, check the above guidelines for accuracy and then administer it to a student or other individual. Calculate the frequency correct.

GUIDELINES FOR ADMINISTERING PROBES

After the mixed probes have been administered and appropriate single probes have been developed, adherance to several guidelines or "short cuts" will assist the teacher in developing a successful, precision teaching program that is functional for the entire classroom. These guidelines are as follows:

1. The administration of written probes can be performed in group settings. After 1 minute, the teacher merely requests that all students stop and put their pencils down. If some

students are completing 1 minute probes while others are completing 2 minute probes, then the teacher merely calls out "1 minute" (after 1 minute elapses), which signals those students taking the one minute probe to stop while the other students continue responding until the teacher directs the students to stop. It does not matter if students are working on different types of probes.

2. Although 1 minute probes are typical, 30 second probes may be more appropriate for secondary level or more advanced students. It is best to get at least 10 movements on a tool skill probe and enough movements on a single probe to identify the instructional level as exemplified in the table within Appendix D.
3. For most students, it is best to let them practice the skill before administering the probe to them. If the student is unlikely to complete the probe during the time allotted, then a row on the probe sheet may be used for practice.
4. Administer the same probe several days in a row. Having many different probes for the same single skill is not necessary. Although students might memorize the responses on a particular probe, this is acceptable because a major part of skill acquisition includes the memorization of academic facts.
5. Relinguish probe administration to the students. Research on self monitoring and self charting indicates that greater involvement results in higher student performance. One

method for accomplishing this is through the use of individual student folders and learning centers. In this situation, each student has his or her own folder. The folder is divided into reading, arithmetic, and spelling (or other areas depending on the students academic level). Listed in each section are the activities and probes that the student must complete for the day. The student moves from one learning center to the next as he or she completes the appropriate day's activities and probes. The probes at each learning center are stored in a box, notebook, cabinet, etc. Even if students have difficulty reading, they soon identify the probes listed in their folder because the same probe is administered for many continuous days. A stop watch or athletic watch showing minutes and seconds and having a start/stop button is kept at each center. If several students are at the learning center during the same time, then they can work individually or on cooperative assignments and take turns timing each other. Correctly completed probes or answer keys to each probe are also kept at each center so the student can score his or her own paper. With little training, students can calculate their frequency correct and incorrect (a calculator should be available) and plot their scores on their own graph, which is kept in their individual folder. Students should also put the completed probes (or transparencies if these are used) in his or her folder so the teacher can perform an

error analysis to enhance academic instruction. If learning centers are not used, then the teacher can place the appropriate probes into each student's folder.

GUIDELINES FOR SCORING PROBES

The following guidelines for scoring probes may be useful in implementing a precision teaching program in the classroom.

1. Develop answer keys for all probes so the students can self evaluate their performance. Self evaluation enhances performance while it increases student responsibility.
2. Record scores immediately so no data is lost. Having a place on the back of each probe for the score is useful. Because most probes are only photo-copied on the front, then an ink pad and a specially designed rubber stamp showing student information (name, pinpoint behavior, number correct/incorrect, minutes, and frequency can be used to record the scores on the back of the probe. Permit the students to stamp the back of their own probe and fill-in the information accordingly. If transparencies are used to protect students from writing on the probe, then the raw data can be recorded on the chart. Some charts used in precision teaching have a place for this information, otherwise the raw data can be written on the back of the chart.
3. All academic responses can be scored in different size units. If the student reads a reading passage, for

instance, the material can be scored according to the number of sentences read correctly, the number of words read correctly, or the number of syllables read correctly. Likewise, a math assignment can be scored in different size units. The teacher might score the number of pages, rows, problems, or intergers correctly completed. The smaller the unit, the more sensitive is the measure. Smaller units provide more information about the student's performance. Although smaller units are more tedious to score, they are more motivating for students. By using smaller units, the student receives credit for partially correct responses. If for instance, an answer to an addition problem is 2065 and the student writes 2365, then he or she receives credit for 3 correct responses. The table of proficiency levels in Appendix D is based on small units. The reading data is based on words read per minute, spelling data is based on letters spelled per minute, and the arithmetic is based on numerals in the answer written per minute.

ACTIVITY 7

Listed below is a sample of problems taken from a probe. The problems were completed in 2 minutes, 15 seconds. As a teacher, you want to score the problems using a small unit (numerals). Score the problems and calculate the frequency correct and the frequency incorrect. Then check your answer with the Answer Key following the activity.

34	31	43	72
+12	+26	+15	+23
46	52	58	85
86	57	48	74
+13	+42	+31	+14
92	59	76	88

ANSWER KEY

$$\text{F correct} = \frac{\text{Number of correct numerals}}{\text{minutes}}$$

$$\text{F correct} = \frac{11}{2.25} = 4.89 \text{ correct numerals per minute}$$

$$\text{F incorrect} = \frac{\text{Number of incorrect numerals}}{\text{minutes}}$$

$$\text{F incorrect} = \frac{5}{2.25} = 2.22 \text{ incorrect numerals per minute}$$

CHAPTER 4

CHARTING

After the teacher (or student) has developed, administered, and scored the probe, it is time to graph the data on a chart. Charting student data is an intregal part of precision teaching. A chart of the student's scores provides a visual picture of how the individual is performing. It is an important tool for motivating the student because the student competes with his own record and sees the results of his work (Dvorak, Merrick, Dealey, & Ford, 1936). In addition, the chart assists the teacher in continuously monitoring the student's performance so precise instructional decisions can be made quickly. The chart functions as a cue for the teacher, indicating that the student is either acquiring the academic skill at an adequate rate or is not making sufficient gains and thus a change in intervention is warranted.

The original chart used in precision teaching and developed by Ogden Lindsley is called the Standard Behavior Chart (see Appendix F). This logarithmic chart records all countable human behavior with equal sensitivity. The chart is designed to record an entire range of frequencies starting with very infrequent behaviors occurring only once in 24 hours to very frequent behaviors occurring 1000 times per minute. This range in frequencies is charted on one graph without changing the chart's scale. Hence, the instrument is considered a standard chart on which all behavior can be recorded.

The Standard Behavior Chart is also referred to as a multiply-divide and an equal ratio chart. Because the chart reflects proportional (as opposed to additive) change or growth, the chart is divided into equal ratios or proportions rather than equal intervals. Almost all evaluation measures, therefore, are derived through multiplying or dividing rather than adding or subtracting. All of this is in contrast to traditional equal interval graph paper where spaces between lines are equal and student performance is calculated by adding or subtracting the number of squares on the chart.

As precision teaching has evolved over the years, some changes have been made in the original Standard Behavior Chart. In making these modifications, great care has been made not to distort specific features of the chart. Enlarging the chart through photo-copying is not an acceptable modification because this distorts the data by turning the chart into a non-standard instrument. Incorrect instructional decisions can result when data is plotted on a non-standard chart. Appropriate changes in the Standard Behavior Chart have been made to make the chart more applicable to school settings. For instance, because students do not attend school for 24 continuous hours, and because few academic behaviors occur at frequencies of 1000 per minute, some charts have a fewer number of cycles (range of rates). Despite having fewer cycles, the proportional distance between the lines has remained constant. One example of a modified Standard Behavior Chart is the ABC-5 chart developed by

William Wolking (1985). See Appendix G. This chart is specifically designed for classroom use and thus has fewer cycles, provides a space for recording raw data, and retains a proportional scale. Because precision teachers are generally interested in evaluating student performance in the classroom, this chart will be further described and used for training purposes.

CHART DESCRIPTION

At the bottom of the chart is a series of labeled blanks. The following definitions serve as guidelines for who and what to chart.

Name. Name of the student whose behavior is charted.

Age. Student's age at the time the charting starts.

Empty line. Space for recording any additional information that is important (e.g. grade level, school name, or service delivery model).

Pinpoint. Pinpoint behavior and the skill unit that is charted.

Aim. Frequency aim or goal.

RAW DATA

To the right of the chart is a series of boxes containing diagonal lines. These boxes provide space for recording the raw

data. If frequency correct and incorrect are being recorded, then the number correct and incorrect can be marked in the box for each day. Or, if just one frequency measure is being recorded (e.g. frequency correct) then the minutes can be marked in the box. Because academic behavior is rarely counted on Saturdays and Sundays, these boxes are smaller than the boxes for Mondays through Fridays. Having the raw data next to the chart is advantageous for checking the accuracy of the plotted data points. In addition, the boxes provide a place for all students to record their data if they are unable to plot the data on the lined chart.

DAY LINES

Day lines are the vertical lines on the chart that represent the calendar day on which the behavior occurs. The chart begins on Monday (as indicated by an "M" at the top of the chart) and continues to Sunday. The Sunday day lines are darker so the chart can be easily subdivided into weekly units.

The numbers at the top of the chart (1-11) represent weekly units. The numbers are beneficial when referring to the student's scores during a particular week.

The numbers at the bottom of the chart represent the successive day lines. These numbers provide a convenient method for referring to a particular day or data point.

FREQUENCY LINES

Frequency lines are the horizontal lines on the chart. The

frequency values start at .1 at the bottom of the chart and increase to 500 at the top of the chart. Numbers showing the frequency value of the line are located to the left of the chart. A frequency value of .1 means that one movement of behavior occurred in a ten minute period (.1 movement of behavior in 1 minute "translates" to one movement of behavior in 10 minutes because 1/10 of a movement of behavior does not occur). A frequency value of 500 indicates that 500 movements of behavior occur in 1 minute.

The frequency lines are arranged in a pattern starting with large spaces between lines and ending with smaller spaces between lines within each cycle. The cycles go from .1 to 1, from 1 to 10, and from 10 to 100. The last cycle, 100 to 500 is incomplete because it does not extend to 1000.

CHARTING FREQUENCIES

There are three steps for plotting a frequency score on the chart (Koorland & Martin, 1975; Pennypacker, et al., 1972). These include:

1. Finding the correct day line.
2. Finding the correct frequency line.
3. Putting a dot where the day and frequency lines cross.

If, for example, a student correctly completes 3 single digit addition problems in 1 minute (F = 3/minute) on the first

Monday, then the teacher or student should put a dot at the intersection where the first Monday and the frequency line, having a value of 3, intersect.

Sometimes a frequency line does not exist and the charter must then estimate the location of the frequency line and put the frequency dot where the day line and the estimated frequency line cross. If, for example, the frequency is 25 movements per minute, then a frequency dot is placed about half way between the 20.0 and 30.0 frequency lines.

Days in which frequency data are collected and charted are referred to as "recorded days." In general, lines connecting the frequency dots are drawn for recorded days.

For academic behaviors, both frequencies correct and incorrect are usually recorded. Precision teachers are interested in the change in the frequency of correct movements of behavior as well as changes in the frequencies of incorrect movements of behavior. Instead of using dots, frequencies of incorrect movements are plotted using small "x's." Data lines connecting the x's are drawn between recorded days.

Data regarding measures of duration and latency are charted in the same way as frequency.

CHARTING DAYS OF NO DATA

There are two situations when data is not available. In the first situation, the behavior occurs but is not counted. This is called an "ignored day." Suppose, for example, the teacher

wants to reduce the frequency that a student curses. The teacher collects and records the data daily. On one day, however, the class goes on a field trip and the teacher is unable to closely observe the frequency of the behavior. Undoubtably, the cursing behavior occurs but the teacher is unable to collect the data. In another example, a substitute teacher requests that the students complete their addition papers. Being unaware of precision teaching, however, the substitute teacher fails to collect the frequency data. The students, therefore, perform the behavior but the precise data is not collected. When an ignored day occurs, the frequency of the target behavior is estimated by drawing a line that connects the frequency dots (and x's) on each side of the ignored day. If more than one consecutive ignored day occurs, then the frequencies are still estimated by connecting the frequency dots of the closest recorded days on each side of the ignored period.

The other situation where data is not available is called a "no chance day". These days are when the behavior has no chance to occur. Most academic behaviors (e.g. addition facts) do not have a chance to occur on Saturdays and Sundays, during field trips, or over holidays. When the behavior has no opportunity to occur, no frequency estimate is made and no entry is made on the chart. Adjacent frequency dots (and x's) are not connected and thus there is a break in the data line on the chart.

ACTIVITY 8

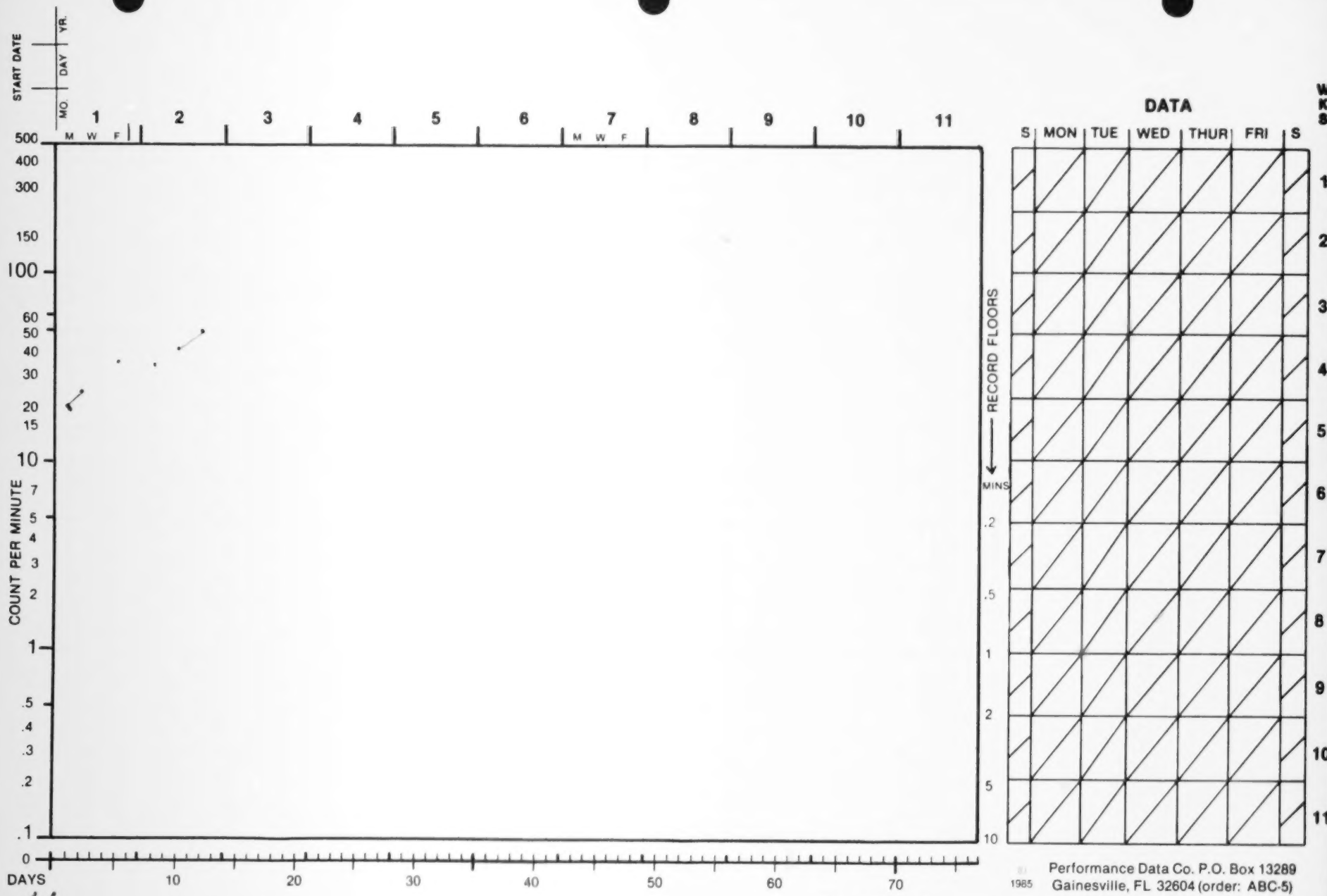
Read the following statements. After each statement,

indicate whether it is an example of a recorded, ignored, or no chance day. Then plot the data on a "precision teaching chart" starting with the first Monday on the chart. The pinpoint behavior is: See-say words. The behavior has a chance to occur on Mondays through Fridays during reading class. After completing the activity, check your responses with the Answer Key and with the chart on the next page.

1. Monday: F = 20 movements/minute
2. Tuesday: F = 25 movements/minute
3. Wednesday: Student is out sick
4. Thursday: Student is out sick
5. Friday: F = 35 movements/minute
6. Saturday: ----------
7. Sunday: ----------
8. Monday: F = 33 movements/minute
9. Tuesday: Student sits in the principals office all day.
10. Wednesday: F = 40 movements/minute
11. Thursday: Stop watch is broken.
12. Friday: F = 50 movements/minute

ANSWER KEY

1. Recorded Day
2. Recorded Day
3. No Chance Day
4. No Chance Day



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Activity 8

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See Say Words

PINPOINT (SKILL NAME – LEARNING CHANNEL – MOVEMENT CYCLE UNIT – DESCRIPTORS)

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5. Recorded Day
6. No Chance Day
7. No Chance Day
8. Recorded Day
9. No Chance Day
10. Recorded Day
11. Ignored Day
12. Recorded Day

ACTIVITY 9

For the following pinpoint behavior (see - write add facts), calculate the frequency correct and incorrect. Record the raw data and the data points on a precision teaching chart. The first problem has been completed for you. The answers are provided in the Answer Key and on the chart following the Activity.

DAY	# CORRECT	# INCORRECT	# MINUTES	F CORRECT	F INCORRECT
1. Monday	10	2	1	10	2
2. Tuesday	8	1	.5		
3. Wednesday	36	4	2		
4. Thursday	40	2	2		
5. Friday	75	3	3		
6. Saturday	--	--	--		
7. Sunday	--	--	--		

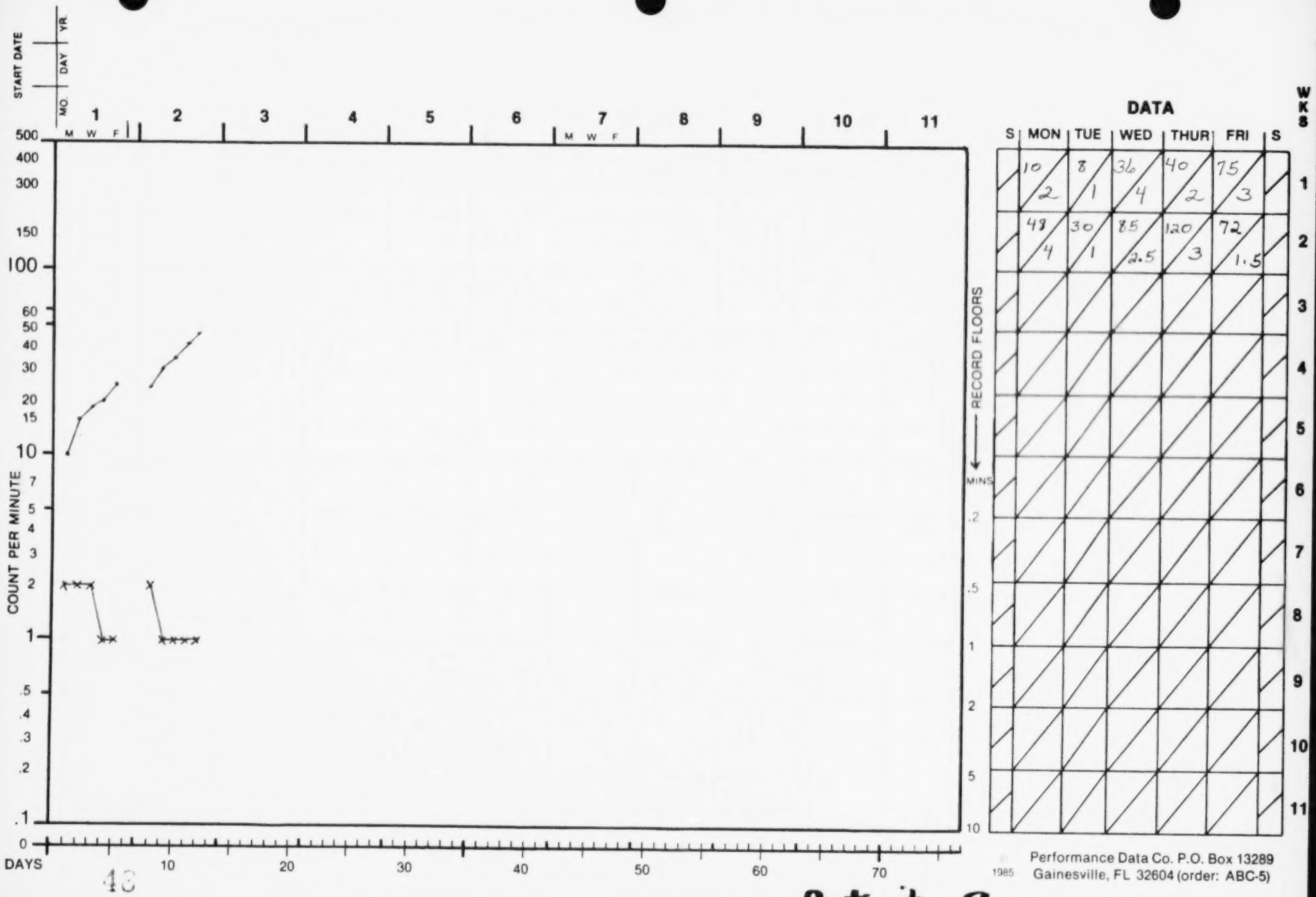
8. Monday	48	4	2
9. Tuesday	30	1	1
10. Wednesday	85	2.5	2.5
11. Thursday	120	3	3
12. Friday	72	1.5	1.5

ANSWER KEY

	F Correct	F Incorrect
1.	10	2
2.	16	2
3.	18	2
4.	20	1
5.	25	1
6.	No Chance Day	
7.	No Chance Day	
8.	24	2
9.	30	1
10.	34	1
11.	40	1
12.	48	1

RECORD FLOOR

The record floor indicates the length of time that is spent recording the behavior each day. It is calculated by:



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Activity 9

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See - Write Add Facts

PINPOINT (SKILL NAME – LEARNING CHANNEL – MOVEMENT CYCLE UNIT – DESCRIPTORS)

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Record Floor = $\frac{1}{\text{Number of minutes spent recording}}$

The record floor is indicated on the chart by drawing a horizontal dash on the frequency line corresponding to the value of 1/number of minutes spent recording. For most academic behaviors, therefore, three marks are recorded on each day line; frequency dot for correct responses, frequency cross for incorrect responses, and dash for record floor. If the time spent recording renmains constant across numerous days, then a straight line (in contrast to separate dashes) is drawn at the record floor value.

ACTIVITY 10

Calculate and plot the record floor for the time intervals below. The first record floor begins on the first Monday. Check your answers with the Answer Key and with the chart following the Activity.

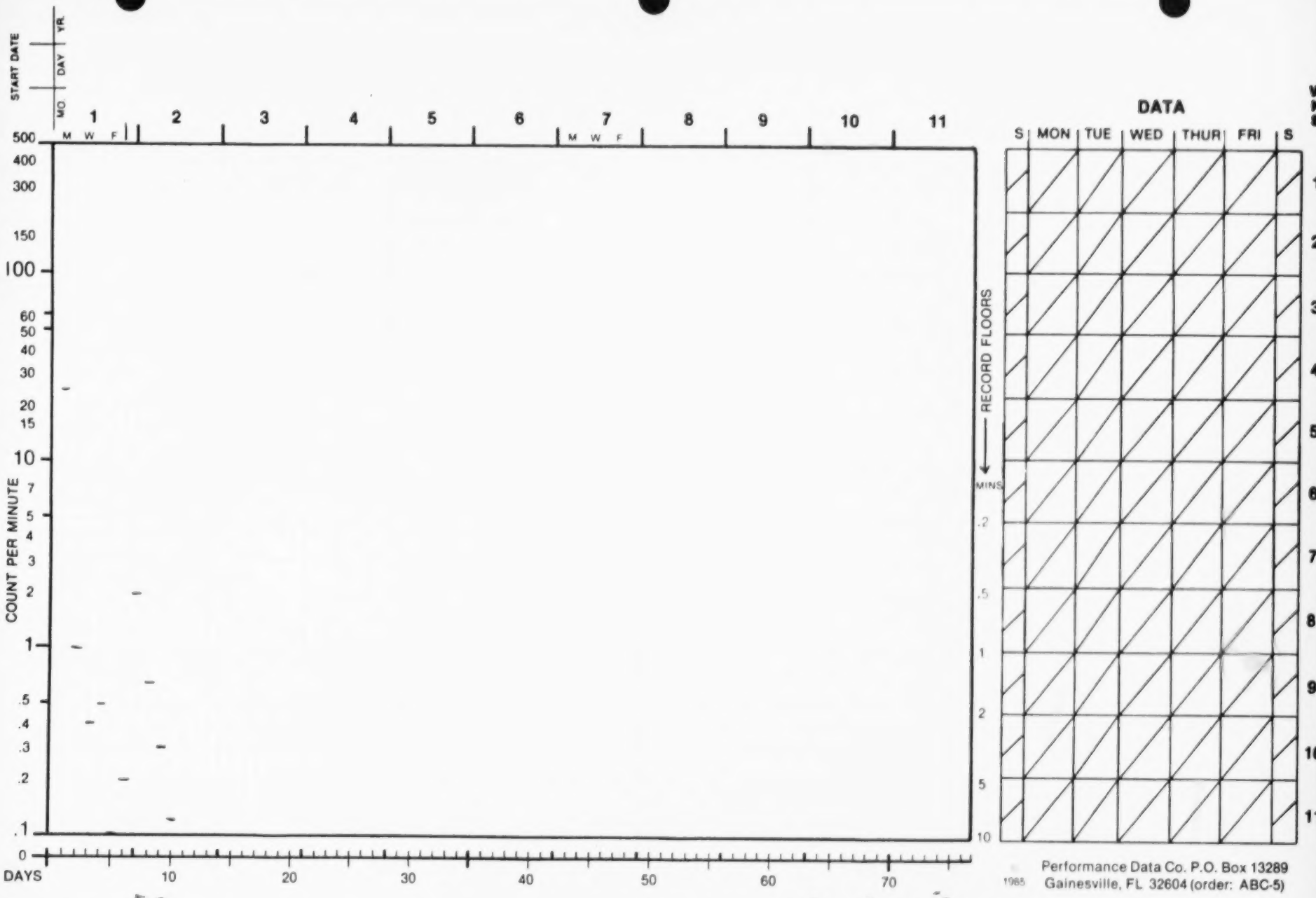
1. 4 minutes
2. 1 minute
3. 2.5 minutes
4. 2 minutes
5. 10 minutes
6. 5 minutes
7. 30 seconds

8. 1.5 minutes
9. 3 minutes
10. 8 minutes

Answer Key

1. RF = 25 minutes
2. RF = 1 minute
3. RF = .4 minutes
4. RF = .5 minutes
5. RF = .1 minutes
6. RF = .2 minutes
7. RF = 2 minutes
8. RF = .67 minutes
9. RF = .33 minutes
10. RF = .125 minutes

Besides indicating the duration of each day's recording interval, the record floor is also important for charting "zero" frequencies. Sometimes when recording, the pinpoint behavior will not occur during the recording interval (e.g. a student fails to correctly complete any single digit addition problems during a one minute timing). This is not saying that the behavior never occurs (this can not be justified from a one minute sample of behavior), only that the behavior fails to occur during the recording interval. If the time period is



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extended, it is quite possible that the behavior will occur. The behavior, therefore, is not charted as "zero" but, instead, a frequency dot is placed directly below the dash of the record floor indicating that the behavior occurs at a rate lower than once per time spent recording.

CHAPTER 5

SETTING THE AIM

Single skill probes are administered at least once per day. If the teacher decides to administer a probe two or three times per day, then a decision should be made as to what probe score should be recorded. The teacher may elect to record the best score for each probe, record only the first administration for each probe, or keep a separate chart for each administration of the probe. After several days of recording, a phase change line is drawn to signal the end of the baseline condition. Baseline is the time of assessment (first few administrations of the single probe) when no intervention strategies are implemented. Although there is a need for several repeated measures of a probe to ensure reliability of the results, extensive baseline conditions are generally not emphasized in educational settings. The phase change line is a vertical line drawn on the chart after the last recorded day of the baseline condition.

Following baseline, an intervention condition is implemented. In this phase, an instructional goal is made, an instructional strategy is selected, and the frequency data is charted.

There are several approaches for setting goals or aims. One method requires that the student shoot for "superfluency" in all basic skills (Haughton, 1977, 1980). That is, 200 to 400 movements/minute for all computation and basic writing skills. Although these rates are attainable, such speed may be

unnecessary to ensure retention of the skill when it is in disuse (Evans, Mercer, & Evans, 1983).

Another approach for establishing an instructional aim is through the assessment of tool skills. Basic tool skills should be 1.5 to 2.0 times greater than instructional frequencies (White & Haring, 1980). If, for example, a student writes digits (tool skill) at a frequency of 120 to 160 digits per minute, then the student's aim for writing multiplication facts should be around 80/minute.

ACTIVITY 11

Using the assessment of tool skills described above, calculate the instructional aim for each of the skills listed below. Check your responses with the Answer Key following this Activity.

1. Jane's frequency for writing digits is 60 to 80 digits per minute. What is an appropriate instructional aim for writing subtraction facts?_____

2. Iris says letters at 90 to 120 movements per minute. What is an appropriate instructional aim for reading words?_____

_____

3. Bob writes letters at 75 to 100 per minute. What is an appropriate instructional aim for writing vocabulary words?

_____

Answer Key

1. 40 movements/minute
2. 60 movements/minute
3. 50 movements/minute

Another strategy that also uses the assessment of the tool skill as a guide involves a ratio between the tool and skill frequencies of the student and the teacher. The ratio is:

$$\frac{\text{Adult Skill Rate}}{\text{Adult Tool Rate}} = \frac{\text{Student Skill Rate}}{\text{Student Tool Rate}}$$

For this approach, frequency data on the student's tool rate, teacher's tool rate, and teacher's skill rate (for the behavior in which an instructional aim is being calculated) must be known so the aim of the student's skill rate can be determined. If for example, the student writes numbers at 50/minute (student tool rate), the teacher writes numbers at 100/minute, and the teacher writes subtraction facts at 80/minute, then the student's aim for writing subtraction facts should be set at 40/minute.

$$\frac{80}{100} = \frac{X}{50}$$

ACTIVITY 12

Using the strategy described above (ratio skill/tool), calculate the instructional aim for each of the problems below. Check your responses with the Answer Key following the Activity.

1. Mrs. Jones' writes digits at 200/minute. Her frequency for writing division facts is 75/minute. Sandy, a student in Mrs. Jones' class, writes digits at 100/minute. What is an appropriate instructional aim for Sandy to write division facts?_____

2. Mr. Smith writes letters at 150/minute. His frequency for writing letters/minute in vocabulary words is 120/minute. Ronald, Mr. Smith's student, writes letters at 50/minute. What is an appropriate instructional aim for Ronald to write letters in vocabulary words?_____

Answer Key

1. 37.5/minute
2. 40/minute

A fourth approach for setting the aim is called "competing behaviors times 2" (White, 1985). There are three steps to this process. These include:

1. Identifying a competing behavior that is already in the student's repertoire.

2. Assessing the fluency of the competing behavior.
3. Setting the aim at 2 times the frequency of the competing behavior.

An example of this approach might involve a student who completes addition problems by counting marks or slashes on a paper. Although this behavior is functional, it is slow and somewhat laborious. The student, therefore, needs to acquire a new behavior (e.g. see-say addition facts) that is 2 times the rate of the existing, competing behavior (counting slash marks). The new behavior must be viewed by the student as an expedient behavior that is reinforcing (much time saved). Otherwise, there is little incentive for the student to cease using the previous behavior. Using the steps outlined above, this example includes:

1. Drawing and then counting slashes to solve addition facts (competing behavior).
2. Dividing the number of completed addition facts by the number of minutes in the recording interval (that includes time spent drawing, counting, and writing answers).
3. Setting the aim for see-say addition facts at twice the rate of counting slashes-writing addition facts.

ACTIVITY 13

Using the strategey, competing behaviors times 2, calculate the instructional aim for the problem below. Check your answer

with the Answer Key following the Activity.

1. Mary is a two year old child. She eats her food using her fingers. She is able to successfully get the food into her mouth without spilling at a frequency of .5 bites/minute. What is the competing behavior? What is an appropriate instructional aim?

Answer Key

1. The competing behavior is finger feeding and an appropriate instructional aim is 1 bite/minute.

Finally, the data in Appendix D can be used as a guide for setting an instructional aim.

DYNAMIC AIM

After setting the instructional aim, progress toward the aim must be monitored closely so changes in instructional strategies can be made quickly. Dynamic aim is a procedure for measuring progress toward the aim. This procedure provides rules for making instructional decision regarding if and when an instructional strategy should be modified. The steps for implementing this procedure include:

1. Record three days of data (F correct).
2. Place an open dot where the median frequency line and the

median day line intersect. This is the "start point."

3. Set the aim based on one of the approaches discussed.
4. Place the "A star" on the aim. The apex of the "A" is located on the day for which the goal is set. The cross bar of the "A" is located on the frequency line.
5. Connect the start point with the frequency line of the A star.
6. If three consecutive data points fall below the expected celeration, then the goal is probably attainable and thus a change in the instructional strategy should be made.

ACTIVITY 14

Listed below are three data points and an instructional aim for each problem. Graph the data points and the "A star" on a chart. Calculate the start point and connect the start point with the frequency line of the A star. Check your answers with the Answer Key following the Activity and with the graph on the following page (both problems are located on the same graph).

1. Monday = 10 movements/minute
   Tuesday = 20 movements/minute
   Wednesday = 15 movements/minute
   A star is located 2 weeks after the Monday at a frequency of 60 movements/minute.
2. Tuesday (day 30 on the chart) = 2 movements/minute
   Wednesday = 1 movement/minute

Thursday = 1.8 movements/minute

A star is located 3 weeks after the Tuesday at a frequency of 10 movements/minute.

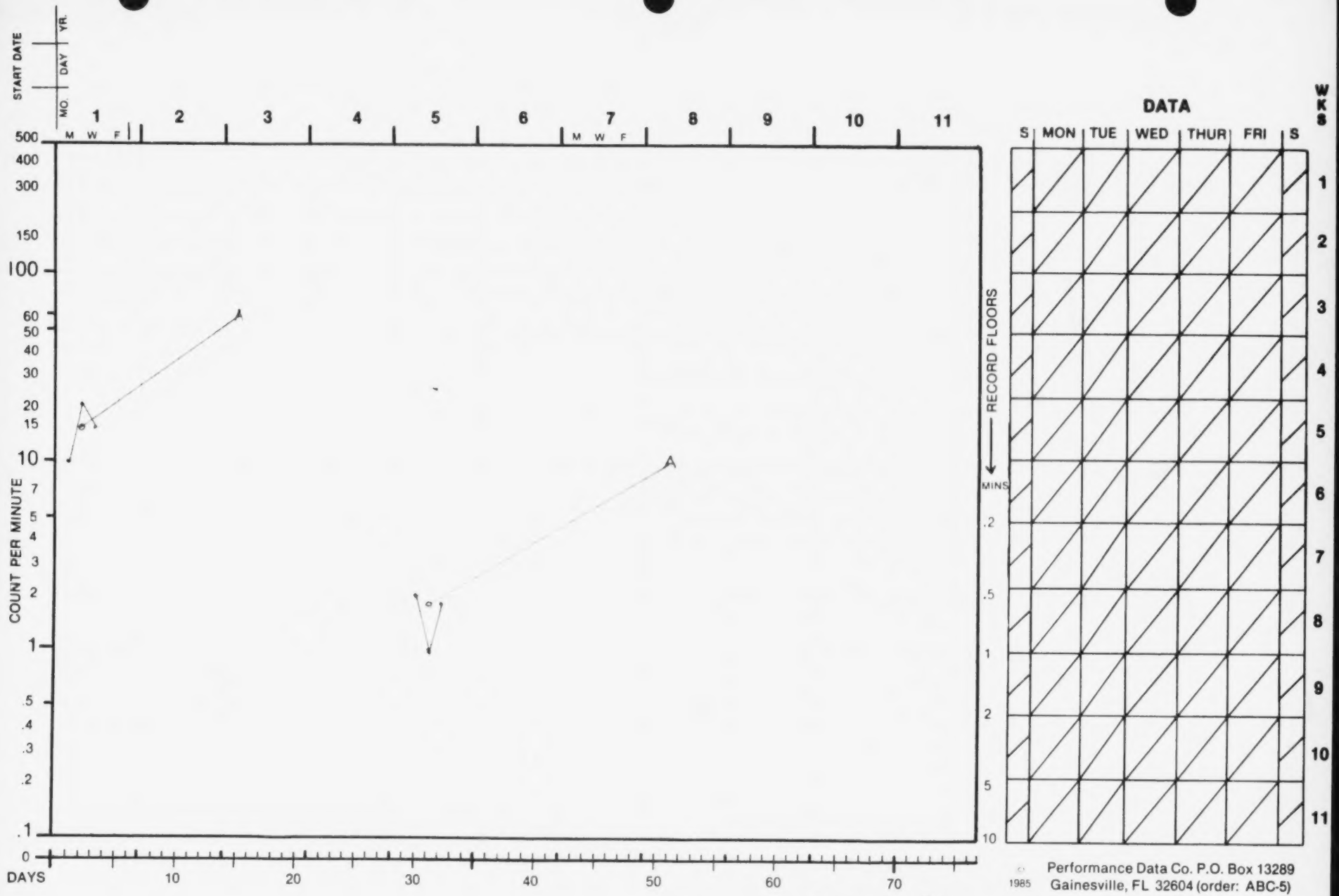
Answer Key

1. Start point is located on Tuesday at a frequency of 15 movements/minute. The apex of the A is on Monday (2 weeks following the first data point) and the cross bar of the A is on the frequency value of 60 movements/minute.
2. Start point is located on Wednesday (day 31) at a frequency of 1.8 movements/minute. The apex of the A is on Tuesday (3 weeks following the first data point) and the cross bar of the A is on the frequency value of 10 movements/minute.

SELECTING INSTRUCTIONAL STRATEGIES

Precision teaching provides a systematic evaluation of teaching strategies. It does not dictate what strategy the teacher must use but, instead, provides specific rules for charting, recording, and analyzing the effectiveness of the selected strategies. The purpose of this section, therefore, is not to dictate what instructional strategies should be used, but to provide the teacher with some resources for selecting a useful strategy.

Lovitt (1984) provides a descriptive compilation of 112 instructional strategies spanning the areas of reading, arithmetic, independence (self instructional strategies), and



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Activity 14

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AIM

behavior management. For each strategy, Lovitt provides information regarding background, who can benefit, procedures, modifications, and research. The majority of these strategies can be implemented and their effectiveness evaluated through precision teaching.

Drill and practice is a common teaching method that has proven effective across all levels of education (Humphrey, 1983). Drill consists of frequent repetition of the task until the student has mastered the skill. In precision teaching, the drills are timed and feedback regarding the frequency correct and incorrect is provided to the student. Data from the drills is not necessarily recorded because the drills are performed and the data are collected in addition to the timed probes.

Safmeds are timed flashcards that are also used in precision teaching. The front of the card contains problems or questions concerning the type of information that is to be acquired (e.g. add facts, history questions, etc.). If questions are written on the cards, then such questions are abbreviated, so time is not lost by the student reading the questions. To further enhance speed (by reducing the risk of being cumbersome), the cards are kept very small (2 X 2 or 3 X 3 inches). The student frequently makes his or her own cards, flashes the cards to himself or herself, checks the accuracy of the responses, and keeps a record of the frequency (recorded in the student's notebook, folder, or on a chart). The student is encouraged to keep the safmeds within easy reach so they can be used during

"spare time" (waiting for class to start, at the end of the lunch break, or when assignments are completed early).

CHAPTER 6

EVALUATING THE EFFECTIVENESS OF THE INSTRUCTIONAL STRATEGY

After selecting the instructional strategy for intervention, it is necessary to measure the effectiveness of the intervention. Although it is possible to record the data and passively observe whether the frequency data on the chart tend to increase (accelerate) or decrease (decelerate), a more precise procedure exists that provides a numberical meaure of the chages in frequency. This procedure is called "celeration" and is defined as a measure of change over time.

In order to use celeration for measuring the changes in frequency over time, it is necessary to draw a celeration line throught the set of frequency dots. There are two methods for drawing a celeration line including the Freehand Method and the Quarter-Intersect Method.

Freehand Method

In the freehand method, the teacher or student, visually identifies the trend and direction of the frequency dots and draws a straight line through the center of the dots. Of the two methods for drawing a celeration line, the freehand method is quicker, easier, and in general, is quite accurate. If students are calculating their celeration measures, then the freehand method is recommended.

QUARTER-INTERSECT METHOD

The quarter-intersect method is used when it is difficult to visually identify the exact trend of the frequency dots. The procedures for using the quarter-intersect method include:

1. Draw a vertical line on the chart halfway between the time period covered by the frequency dots (include ignored and no chance days). Thus, divide the data into two equal parts.
2. Divide each half of the data into half, again, using the same procedure as in number 1. Thus the entire data is divided into quarters.
3. Locate the median frequency of <u>each</u> half period.
4. Put a dash where the median frequency value and the quarter line intersect for each of the half periods.
5. Draw a line connecting the dashes. This line forms the celeration line which is used for measuring the trend and direction of the frequency dots.

ACTIVITY 15

Plot the following data on a chart. Draw a celeration line using the Quarter-Intersect Method and answer the questions. Then check your answers with the Answer Key and with the chart following the Activity.

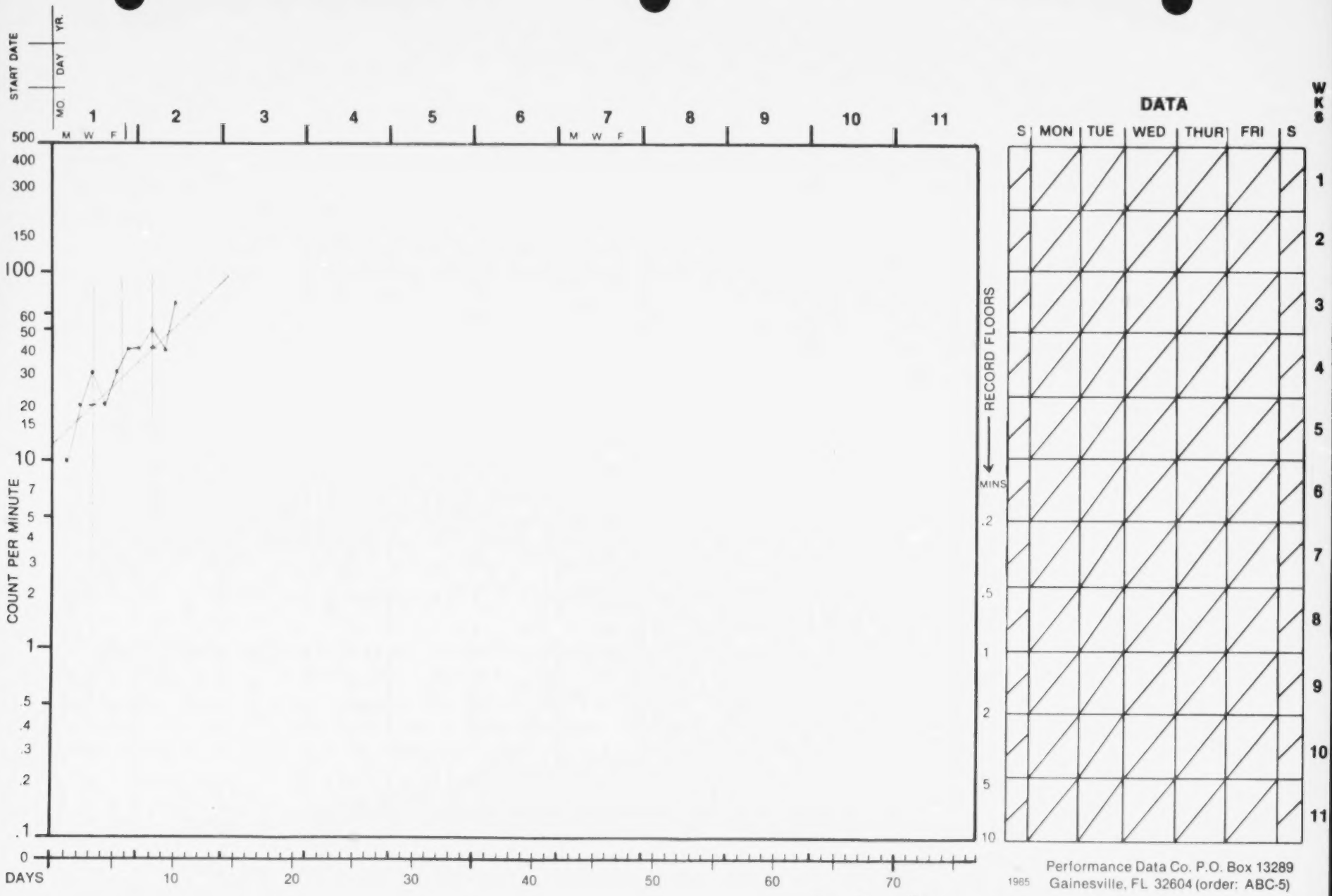
DAY	FREQUENCY
Monday	10

Tuesday	20
Wednesday	30
Thursday	20
Friday	30
Saturday	40
Sunday	40
Monday	50
Tuesday	40
Wednesday	70

1. The half line occurs between_____ (day) and_____ (day).
2. The quarter lines occur on_____(day) and_____ (day).
3. The dash for the first quarter is on_____(day) at _____(frequency).
4. The dash for the second quarter is on_____(day) at _____(frequency).

ANSWER KEY

1. Friday, Saturday
2. Wednesday, Monday
3. Wednesday, 20/minute
4. Monday, 40/minute



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Activity 15

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PINPOINT (SKILL NAME — LEARNING CHANNEL — MOVEMENT CYCLE UNIT — DESCRIPTORS)

AIM

CELERATION VALUE

After developing the celeration line, a numerical value of the celeration can be calculated. The steps include:

1. Identify any two frequency dots that are seven calendar days apart (thus, recording period must be for at least seven days).
2. Divide the larger frequency value by the smaller frequency value.
3. If the larger frequency value represents the second of the two frequency dots (referring to chart location) then place an "X" in front of the quotient. The "X" indicates that the celeration of the frequency dots is increasing or accelerating.
4. If the smaller frequency value represents the second of the two frequency dots, then place a "÷" in front of the quotient. The "÷" indicates that the celeration of the frequency dots is decreasing or decelerating.
5. If both frequencies have the same value, then put an "X" in front of the quotient. Horizontal lines have a celeration value of X1.

ACTIVITY 16

For each problem, two frequency values on a celeration line are provided. Plot the frequencies and connect the dots. Then calculate the celeration value for each problem. Answers are provided in the Answer Key following the Activity.

1. First Monday, F = 5

   Second Monday, F = 25

2. Third Tuesday, F = 30

   Fourth Tuesday, F = 6

3. Fifth Wednesday, F = 40

   Sixth Wednesday, F = 20

ANSWER KEY

1. 25/5 = X5
2. 30/6 = ÷5
3. 40/20 = ÷2

DECISION RULES

Changes in the instructional strategies are made if one or more of the following conditions occur.

1. There are 3 days of flat data.
2. The value of the celeration line is less than X1.25
3. The frequency correct decelerates.

If one of these conditions occur, then modifications regarding the practice environment, the task, or the use of motivating techniques can be implemented before a total change in the instructional strategy occurs.

Altering the practice environment includes several methods. These methods are:

1. Providing the student with multiple timings throughout the session.
2. Provide the student with additional chances for timed practice.
3. Permit the students to work with partners. This technique serves two purposes. First, working with a classmate may be reinforcing to the students. Second, one student can serve as a model or example of a fluent learner for the other student.
4. When the student is working on an assignment, pace the student's work by saying "next" at a fixed interval of time (e.g. 3 to 5 seconds). This prompt indicates to the student to continue to the next problem.
5. Provide the student with opportunities for untimed practice.

The task can also be modified. Such modifications include:

1. Provide the student with answers to the problems. Providing answers assists the student in working for the correct response.
2. Pair the tool skill and single skill by administering the tool skill probe and then administering the single skill probe. This technique provides some generalization of speed from the tool to the skill probe.
3. Slice the skill or slice the format.
4. If the skill has already been sliced to a rudimentary level

and frequencies are not accelerating, then step back to a tool skill.

Motivational techniques should always be used to increase the effectiveness of an instructional strategy. Motivational techniques include:

1. Provide feedback to the student regarding his or her performance. This is easily done by plotting the data on the chart.
2. Provide reinforcers to the student for increases in frequency (or duration).

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APPENDIX A

TABLE

FRACTIONAL PARTS OF A MINUTE

Seconds		Fraction of Minute
1	=	.02
2	=	.03
3	=	.05
4	=	.07
5	=	.08
6	=	.10
7	=	.12
8	=	.13
9	=	.15
10	=	.17
11	=	.18
12	=	.20
13	=	.22
14	=	.23
15	=	.25
16	=	.27
17	=	.28
18	=	.30
19	=	.31
20	=	.33
21	=	.35
22	=	.37
23	=	.38
24	=	.40
25	=	.42
26	=	.43
27	=	.46
28	=	.47
29	=	.48
30	=	.50

Seconds		Fraction of Minute
31	=	.52
32	=	.53
33	=	.55
34	=	.57
35	=	.58
36	=	.60
37	=	.62
38	=	.63
39	=	.65
40	=	.67
41	=	.68
42	=	.70
43	=	.72
44	=	.73
45	=	.75
46	=	.77
47	=	.78
48	=	.80
49	=	.82
50	=	.83
51	=	.85
52	=	.87
53	=	.88
54	=	.90
55	=	.92
56	=	.93
57	=	.95
58	=	.97
59	=	.98
60	=	1.00

APPENDIX B

SEE-WRITE MATH FACTS

666 + 41	18 + 9	648 + 25	35 +47	15 + 4	7064 + 424
121 323 120 +202	778 + 8	446 + 25	48 + 8	3865 5738 +2620	186 + 5
219 +382	2865 3739 +4620	51 + 8	9173 +1898	58 +62	943 +164
47 +58	513 +191	456 266 254 +168	35 +22	964 + 6	8872 +1162
4787 8293 +7846	746 +221	756 + 23	372 +162	123 + 45	880 + 20

APPENDIX C

BASIC MULTIPLICATION FACTS - 4's

6 x4	3 x4	8 x4	9 x4	3 x4	4 x2
2 x4	3 x4	4 x9	7 x4	2 x4	4 x3
8 x4	4 x9	4 x6	4 x0	5 x4	6 x4
0 x4	7 x4	4 x8	6 x4	4 x7	4 x3
8 x4	4 x6	5 x4	4 x4	4 x1	10 x4

APPENDIX D

PROFICIENCY LEVELS FOR READING, SPELLING, & ARITHMETIC -- Adapted from Ann & Clay Starlin

These proficiencies are based on one minute samples. They are intended to serve as general guides. The reading data is based on words read per minute. Spelling data is based on letters spelled per minute and the arithmetic is based on numerals in the answer written per minute.

Decision Options	Reading Performance		Spelling Performance		Arithmetic Performance		Action
	K-12	3-Adult	K-2	3-Adult	K-2	3-Adult	
INDEPENDENT	50-70 corr. and 2 or fewer errors	100-200 and 2 or fewer errors	30-50 corr. and 2 or fewer errors	50-70 corr. and 2 or fewer errors	20-30 corr. and 2 or fewer errors	40-60 corr. and 2 or fewer errors	Move to next level
INSTRUCTIONAL	30-45 corr. and/or 3-6 errors	50-99 corr. and/or 3-6 errors	15-29 corr. and/or 3-7 errors	25-49 corr. and/or 3-7 errors	10-19 corr. and/or 3-8 errors	20-39 corr and/or 3-8 errors	Active teaching level - as error analysis; analyze teaching rputine; and analyze equation component
FRUSTRATION	0-29 corr. and/or 7 or more errors	0-49 corr. and/or 7 or more errors	0-14 corr. and/or 6 or more errors	0-24 corr. and/or 8 or more errors	0-9 corr. and/or 9 or more errors	0-19 corr and/or 9 or more errors	Slice pinpoint take samples of prerequisite skill to find weaknesses

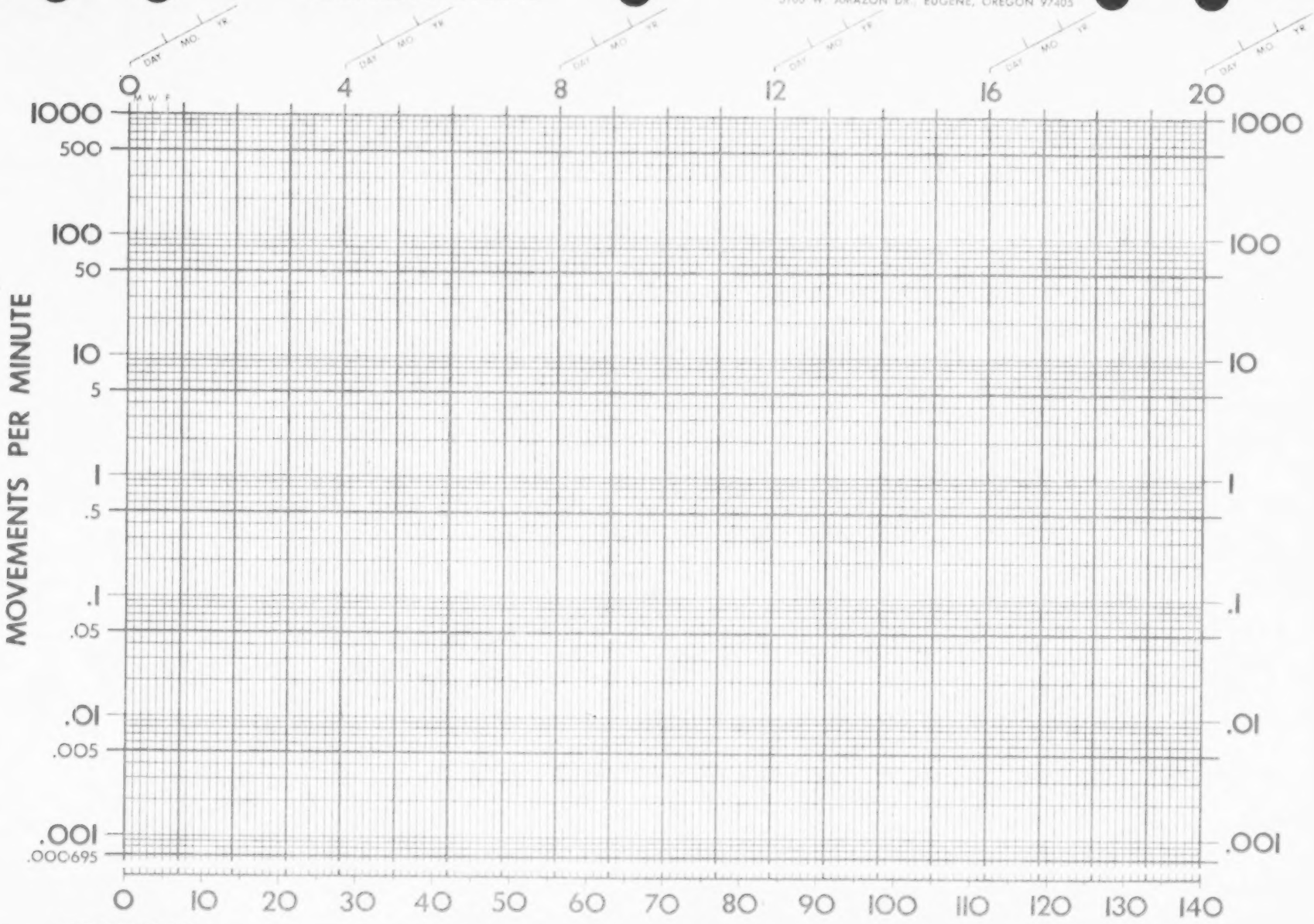
APPENDIX E

WRITE LETTERS OF ALPHABET

APPENDIX F

24 HOUR - 20 WEEK BEHAVIOR CHART
GRAPHICS FOR BEHAVIORAL MEASUREMENT
5100 W. AMAZON DR., EUGENE, OREGON 97405

CALENDAR WEEKS



PROJECT TEAM

SUPERVISOR _____ BEHAVER _____

ADVISOR _____ AGE ___ LABEL _____

MANAGER _____ NOTES _____

COUNTER 91 CHARTER _____

MOVEMENT CYCLE

NAME IT _____

COUNT WHEN _____

_____

_____ OCCURS

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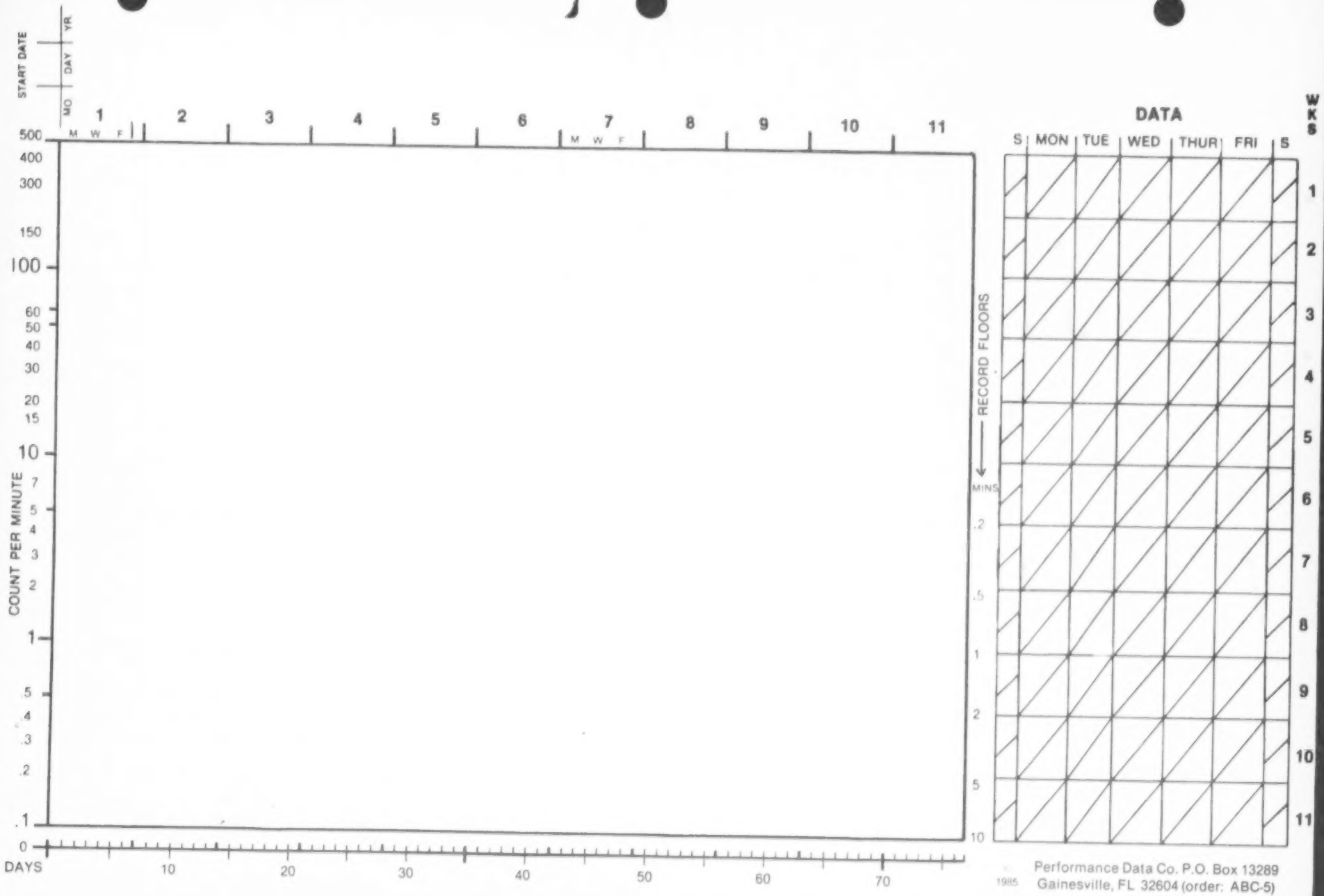
APPENDIX G



1985 Performance Data Co. P.O. Box 13289 Gainesville, FL 32604 (order: ABC-5)

NAME 94 AGE 95 96

PINPOINT (SKILL NAME – LEARNING CHANNEL – MOVEMENT CYCLE UNIT – DESCRIPTORS) AIM